

# PATENT ABSTRACTS OF JAPAN

(11) Publication number : 06-196176

(43) Date of publication of application : 15.07.1994

(51)Int.Cl. H01M 8/00  
F23N 5/24

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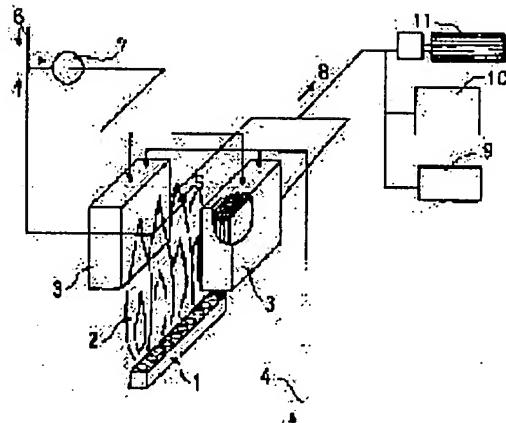
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**(54) COMBUSTION EQUIPMENT**

(57) Abstract:

**PURPOSE:** To provide a combustion equipment with which electric power supply from outside can be dispensed and by which an apparatus installing place is not restricted and convenience in use can be improved and reliability against unexpected power failure or the like can be also improved.

CONSTITUTION: A high temperature fuel cell type power generating element 3 is arranged in combustion flames 2 or very close to them, and an operation temperature of the high temperature fuel cell type power generating element 3 is held by heat of the flame 2, and electric power is generated by using raw material fuel gas 4 for a combustion equipment 1 or unoxidized hydrocarbon, hydrogen, radical or the like existing in the flames 2 as fuel. The generated electric power 8 of the high temperature fuel cell type power generating element 3 is supplied to an electronic circuit 10, a motor-driven fan 11 and a storage battery 9 used for starting and backup.



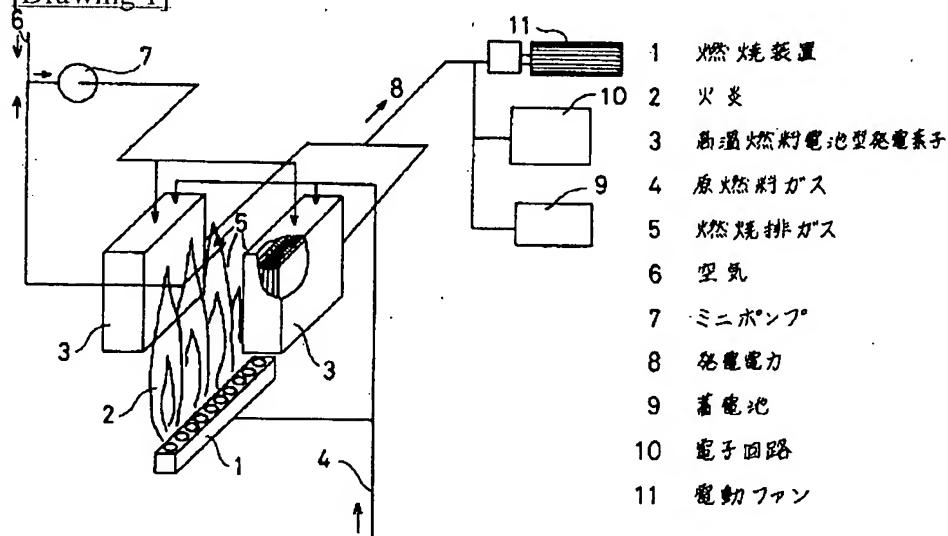
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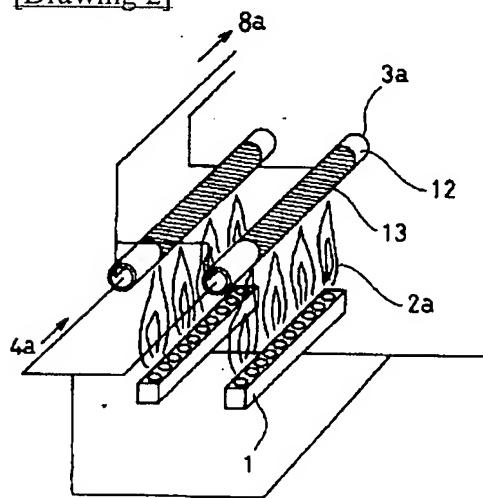
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## DRAWINGS

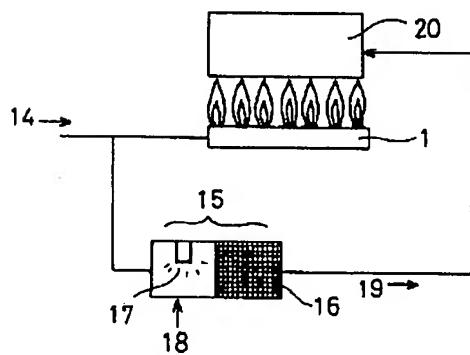
[Drawing 1]



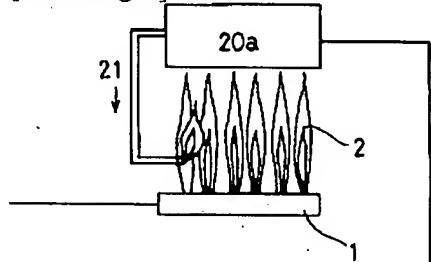
[Drawing 2]



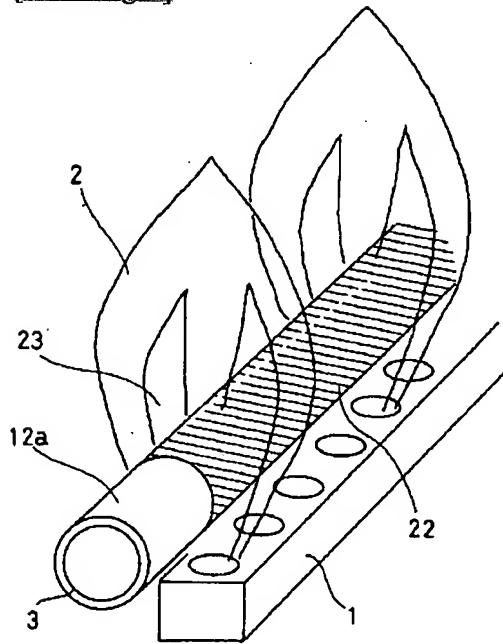
[Drawing 3]



[Drawing 4]



[Drawing 5]



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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] The burner block diagram with a generation-of-electrical-energy function of the 1st example of this invention

[Drawing 2] The important section perspective view of the burner with a generation-of-electrical-energy function of the 2nd example of this invention

[Drawing 3] The important section block diagram of the 3rd example of this invention

[Drawing 4] The 4th example important section block diagram of this invention

[Drawing 5] The 5th example important section perspective view of this invention

**[Description of Notations]**

- 1 Burner
- 2 Flame
- 3 High Temperature Fuel Cell Mold Generation-of-Electrical-Energy Component
- 4 Original Fuel Gas
- 5 Combustion Gas
- 6 Air
- 7 Mini Pump
- 8 Generated Output
- 9 Battery
- 10 Electronic Circuitry
- 11 Electric Fan

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] Especially this invention relates to the burner which has a generation-of-electrical-energy function as an additional function about a burner.

#### [0002]

[Description of the Prior Art] The small-scale burning appliance which used a burning appliance especially kerosene, and gas as the fuel has very many opportunities used as an object for private demand. In using the equipment, in the burner for such an application for heating, for example, an object, and hot-water supply, the power for driving various control units, an electric fan, etc. is needed in many cases. A microcomputer etc. is especially carried in recent years and advanced features are achieved in many cases. OK, by such device, an electric power supply is indispensable, and from a device nearby commercial power plug socket, at any time, about power, there is current, also when the dedicated line is prepared by the electrical work in the case of an installation mold device.

[0003] The disadvantage of receiving constraint harder [ which needs an electric power supply ] at the installation of a device in the case of an ejector-half device, and generating, also when taking about a power cord as a result, and supplying power from the outside also from the field of user-friendliness and insurance is in \*\*. Moreover, in the case of an installation mold device, an electrical work may newly be needed and installation becomes complicated. Moreover, although it is recent years very rare, if the case where interruption of service occurs is assumed, it will be in \*\* that such a burning appliance will completely be in an unusable condition, and it will be thought that trouble is caused in respect of a life.

[0004] Since it is such, there is also an idea of giving a generation-of-electrical-energy function to a burning appliance, from before, and how to generate using a thermoelement using the temperature gradient between the elevated temperature of the combustion section and a room temperature etc. is considered.

[0005] Moreover, what adds a fuel cell as a power plant is considered.

#### [0006]

[Problem(s) to be Solved by the Invention] However, the temperature gradient was required for the thing using the former thermoelement because of the generation of electrical energy, and in order to acquire a low-temperature heat source, it had problems, like there is the need for a radiator or forced cooling.

[0007] Moreover, the thing using the latter fuel cell as a generation-of-electrical-energy function needs to supply electrochemically the thing in which a reaction is possible on electrodes, such as hydrogen, as a fuel. For this reason, when the hydrocarbon is being used as a fuel of a burning appliance, it is necessary to reform and supply this.

[0008] However, if the carbon monoxide contains in the fuel, in order for the engine performance of the platinum catalyst currently used for an electrode to fall, the fuel cell which operates around 200 degrees C from a room temperature needs to remove a carbon monoxide in addition to reforming of a hydrocarbon, if it is going to use this type of fuel cell. On the other hand, in the high temperature form fuel cell, since it is elevated-temperature actuation, even if components other than hydrogen contain in

fuel gas, there is no bad influence to an electrode etc. and the freedom over a fuel is highly suitable for simplification of a configuration. However, it is necessary to carry out the temperature up of the cell and to hold it even to cell operating temperature, in a high temperature fuel cell.

[0009] This invention aims at offering the burner using the high temperature fuel cell mold generation-of-electrical-energy component which does not need special heating apparatus with careful attention to said conventional problem.

[0010]

[Means for Solving the Problem] In order to attain said purpose, this invention A burner, a high temperature fuel cell mold generation-of-electrical-energy component, An electronic circuitry, an electric fan, and a high temperature fuel cell mold generation-of-electrical-energy component The inside of a combustion flame, Or arrange to the latest and the battery for starting backup is used as a component. Some original fuels supplied to said burner are supplied to said high temperature fuel cell mold generation-of-electrical-energy component as a fuel, and a part of generated output [ at least ] by said high temperature fuel cell mold generation-of-electrical-energy component is considered as the configuration of the burner which charged said battery.

[0011]

[Function] In the above-mentioned configuration, the heat of the flame of a burner makes a high temperature fuel cell mold generation-of-electrical-energy component hold to the operating temperature, and generates electricity to combustion and coincidence using the fuel for burners. Generated output is used for the electronic circuitry of burner attachment, or the drive of an electrically powered equipment, and uses a part for charge of a battery. A battery supplies need power until a high temperature fuel cell mold generation-of-electrical-energy component starts a generation of electrical energy on the occasion of actuation of the electronic circuitry under burner halt, or starting of a burner. The facility which heats a cell specially is unnecessary and it becomes unnecessary for this reason, to supply from the outside the power which the drive of a burner takes further.

[0012]

[Example] Hereafter, an example is described. Drawing 1 is the important section block diagram of the burner of the 1st example of this invention. To the latest of the flame 2 generated by the burner 1 like illustration, the high temperature fuel cell mold generation-of-electrical-energy component 3 of a small melting carbonate form is arranged. Said high temperature fuel cell mold generation-of-electrical-energy component 3 is installed in the condition of facing on both sides of a flame, using two things which carried out 5 cel laminating of the cell with a magnitude of 5x10cm, and the series connection of this two high temperature fuel cell mold generation-of-electrical-energy component 3 is carried out. Moreover, in order to make bad influences, such as oxidation by the flame 2, into the minimum, the perimeter of the high temperature fuel cell mold generation-of-electrical-energy component 3 is protected in the heat-resistant-alloy case. Original fuel gas 4 is supplied to said burner 1, and a part of this original fuel gas 4 is made to be supplied also to the fuel electrode side of the high temperature fuel cell mold generation-of-electrical-energy component 3. Moreover, he is trying for the combustion gas 5 of a fresh air 6 and a burner 1 to supply carbon dioxide gas and oxygen required for the air pole reaction to the high temperature fuel cell mold generation-of-electrical-energy component 3 with the mini pump 7. And the power 8 of the high temperature fuel cell mold generation-of-electrical-energy component 3 is supplied to the battery 9 in a combustor, the electronic circuitry 10, and the electric fan 11.

[0013] If a burner 1 will be in operating state in the above-mentioned configuration and a flame 2 occurs, the high temperature fuel cell mold generation-of-electrical-energy component 3 will be heated with the heat, and a temperature up will be carried out even to cell operating temperature (at least 500 degrees C or more when it is a fused carbonate fuel cell). In this example, 6C gas (47% [ of hydrogen ] and methane 23% and 18% content of carbon monoxides) was used as original fuel gas 4. Since this original fuel gas 4 contains the hydrogen and the carbon monoxide which can be used as a fuel for a fused carbonate fuel cell, the generation of electrical energy by direct supply is possible for it. On the other hand, since the carbon dioxide gas and oxygen of the delivery high temperature fuel cell mold generation-of-electrical-energy component 3 required for an air pole reaction are supplied for the

combustion gas 5 of a burner 1; and the gaseous mixture of a fresh air 6 to the air pole side of the high temperature fuel cell mold generation-of-electrical-energy component 3 with the mini pump 7, the high temperature fuel cell mold generation-of-electrical-energy components 3 are about 50 mW/cm<sup>2</sup> per unit electrode surface product. It can generate electricity and the power of about 25 W can be obtained on the whole. And a part of power 8 is used for charge of a battery 9, and a part is used as an electronic circuitry 10 and an object for the electric fan's 11 drive.

[0014] Thus, according to this example, for example in the burner for the object for heating, and hot-water supply, the various electronic circuitries 10, the electric fan 11, etc. can be driven, without receiving the electric power supply from the outside. When power is insufficient, it can be coped with by extending the high temperature fuel cell mold generation-of-electrical-energy component 3, and achieving generation-of-electrical-energy capacity.

[0015] Drawing 2 is shown in the 2nd example. In this example, the tubing-like zirconia solid oxide fuel cell is used as high temperature fuel cell mold generation-of-electrical-energy component 3a. And two things of the shape of tubing of the diameter of 2cm and 20cm of generation-of-electrical-energy effective length are used as a zirconia solid electrolyte 12, although an air pole 13 is allotted to the outside of tubing and it is not shown in the tubing inside by a diagram, a fuel electrode is arranged, and fuel gas 4a is supplied to the interior of tubing. This high temperature fuel cell mold generation-of-electrical-energy component 3a is installed near the upper part (oxidizing flame) of flame 2a, where an air pole 13 is exposed.

[0016] If high temperature fuel cell mold generation-of-electrical-energy component 3a is heated by the elevated temperature 800 degrees C or more with a flame in the above-mentioned configuration, in order that oxygen ion conductivity may come out, a generation of electrical energy is started using fuel gas 4a which flows the interior of tubing, and the oxygen which exists despite rarefaction near the high temperature fuel cell mold generation-of-electrical-energy component 3a. Generated output 8a is about 80 mW/cm<sup>2</sup>. When the output of two was totaled, there was an output of about 25 W. This example was also able to use a part of power for charge of a nickel hydrogen battery, and the part was able to use it for an electric fan's etc. drive. [ as well as the above ]

[0017] Drawing 3 shows the 3rd example and the equipment configuration of this 3rd example has composition which added the reforming machine to the 1st example. In addition, drawing 3 extracts and shows the reforming machine and the fuel cell mold generation-of-electrical-energy component part. This thing uses town gas 13A (methane about 85%) as a original fuel 14, and has adopted the partial oxidation method as reforming of original fuel gas. The reforming machine 15 consists of a nickel system reforming catalyst 16, an ignition 17, etc. And the partial oxidation reforming reaction of methane occurs by supply of the moderate air 18, and the reforming fuel gas 19 which is rich in hydrogen with the reaction which becomes  $2\text{CH}_4 + \text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2$  is obtained. This is supplied and generated for the high temperature fuel cell mold generation-of-electrical-energy component 20. With the high temperature fuel cell mold generation-of-electrical-energy component 20, the original fuel of the hydrocarbon system which cannot be used directly can be used by installing the reforming machine 15.

[0018] Drawing 4 shows the 4th example. Although the basic configuration of this whole thing is the same as the 1st example or the 2nd example, it is installing the path which discharges the exhaust gas of high temperature fuel cell mold generation-of-electrical-energy component 20a in the flame 2 of a burner 1, and is carrying out combustion processing of the intact fuel. Although unreacted hydrogen etc. is contained in the exhaust gas 21 from high temperature fuel cell mold generation-of-electrical-energy component 20a, the combustion calorific value is low to extent which cannot maintain combustion in exhaust gas 21 independent one, and it is usually difficult to make it burn completely. For this reason, exhaust gas 21 is completely burned by discharging in the flame 2 of a burner 1, and the energy which a fuel has can fully be used.

[0019] Drawing 5 shows the 5th example and this thing uses the tubing-like zirconia solid oxide fuel cell as a high temperature fuel cell mold generation-of-electrical-energy component 3. And the fuel electrode 22 is having inside tubing structure which allotted the air pole (not shown) on the outside of zirconia

solid electrolyte tubing 12a, and arranges the installation location of the high temperature fuel cell mold generation-of-electrical-energy component 3 of a parenthesis (near [ 23 ] a root (i.e., a reducing-flame part) of a flame 2). Especially in this example, it did not carry out supplying fuel gas to the high temperature fuel cell mold generation-of-electrical-energy component 3, but the hydrocarbon which exists in a reducing flame as a fuel, hydrogen, a radical, etc. are used. On the other hand, about the air side, the method which supplies air to the interior of tubing by the convection current or diffusion is adopted by this example. In the case of this example, two things of the shape of tubing of the diameter of 2cm and 20cm of generation-of-electrical-energy effective length were used as an electrolyte, but generation-of-electrical-energy capacity turns into a low output [ whole / 20 mW/cm<sup>2</sup> and / output 6W and a precedent ]. Since a fuel electrode 22 is in a flame 2, this originates in oxygen living together the top where the chemical-species concentration which can serve as a fuel is low. However, it is sufficient power for actuation and intermittent valve actuation of an electronic circuitry, and if an application is chosen, the electric power supply from the outside can be made unnecessary.

[0020] As mentioned above, although explanation of this invention was described according to each example, the high temperature fuel cell mold generation-of-electrical-energy component which has configurations other than the example described here in operation of this invention and magnitude may be used. moreover, the supply by supply according to a pump also about supply of air or the convection current, and diffusion -- you may be a method [ how ]. Moreover, that what is necessary is just to be able to hold the operating temperature of a cell, the installation location of a high temperature fuel cell mold generation-of-electrical-energy component may also change with the magnitude of a flame, or the magnitude of a generation-of-electrical-energy component, and should just be the inside of a flame, or near. Furthermore about the load of the class of battery and an electronic circuitry, and others, the class is not asked.

[0021]

[Effect of the Invention] It becomes unnecessary to supply power from the outside by this invention by attaching a high temperature fuel cell mold generation-of-electrical-energy component to a burner so that more clearly than the example described above. Moreover, about the accessory vessel for the drive of a high temperature fuel cell mold generation-of-electrical-energy component, special heating apparatus is unnecessary, also when a fuel reformer is required, is the thing of a comparatively simple configuration and ends.

[0022] Constraint can be received in the installation of a device by this, or the situations, such as taking about a power cord, can be avoided, and user-friendliness and safety improve. Moreover, in the case of an installation mold device, a new electrical work also becomes unnecessary and it is effective in mitigating and the dependability over unexpected interruption of service etc. raising the burden of facility installation greatly.

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[Translation done.]